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ABSTRACT

A survey of the training literature on phoneme awareness suggests that help for slower readers comes in the form of a focus on phonemes through stretched sounding and phoneme isolation in a careful progression that considers the number and choice of phonemes and position in syllables. Stretching and isolating phonemes allows beginners to explore their articulatory boundaries and begin to create a representation of memory. The research on phoneme awareness has largely assumed that the essential awareness task is segmentation. However, various empirical and theoretic problems with segmentation suggest a new conceptualization of phoneme awareness as, at root, a matter of recognizing phoneme identities; that is, recognizing phoneme similarities and dissimilarities in words. The proposed model of reading acquisition, therefore, argues that knowledge of phoneme identities and letter identities are necessary learning grapheme-phoneme correspondences. Knowledge of correspondences then enables the use of letters as visual symbols of phonemes, making it possible for letters to become mediators in working memory. The ability to recognize letters as symbols for phonemes enables the initial decoding breakthrough of phonetic cue reading and facilitates the more advanced phonemic manipulations of blending and segmentation during phonological recoding. In general, attaining sufficient familiarity with phoneme identities to recognize them in the context of spoken words seems to be the initial hurdle in learning to read. (Contains 66 references.) (TB)

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Segmentation or Identity? Reconceptualizing Phoneme Awareness

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The words we speak are composed of a relatively small number of vocal elements, gestures and sounds that are recycled in endless variations. For example, if the above sentence were read aloud, the spoken word speak would begin with the same gesture as the final gesture in the spoken word endless. The elemental vocal gestures from which the spoken words of a particular language are composed are the phonemes of that language.

Knowledge of phonemes becomes important in learning to read alphabetic languages because in these languages, letter sequences are maps of the phoneme sequences in pronunciations. For example, the spelling sight directs the reader to construct a pronunciation that begins with /s/ as represented by s, merges into the vowel /ai/ represented by igh, and finishes with the stop consonant /t/ represented by t. Because skilled readers have long since automatized the link between the spoken word /sait/ and the written word sight, permitting effortless access to its pronunciation, syntactic role, and meaning, we tend to underestimate the problem it presents to beginning readers.

For many children, a formidable difficulty is coming to recognize the phonemes ("sounds") of our spoken language as recyclable components that have variable but finite spellings in written words. This recognition of phonemes has been termed phoneme awareness. It is logically prior to the knowledge of phoneme spellings taught in a phonics curriculum, because it is assumed whenever a spelling-to-sound correspondence is taught.

Children learn the identities of phonemes in many ways. They may be given informal instruction and literacy experiences in their homes that primes them to learn from phonics instruction at school. Their literate tutors may guide their early attempts to read or spell words by pronouncing them so as to emphasize the vocal gestures spelled by certain letters. Through encounters in alphabet books, rhyming and alliterative texts, and word play, many children acquire phoneme awareness.

Unfortunately, not all children arrive at school primed to use the alphabet for reading. For instance, the lowest achieving readers studied by Juel (1988) entered first grade with little awareness of phonemes (their mean phoneme awareness score was 4.2, in contrast to a mean of 21.7 for children who would become good readers). By the end of fourth grade, these children had not reached the level of decoding skill evidenced by good readers at the beginning of second grade. For these children, explicit instruction in phoneme awareness is probably necessary to gain an early foothold in decoding.

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Phoneme awareness programs typically focus on the skills of segmentation and blending. Segmentation is seen as a mechanical process of breaking down spoken words into discrete phonemes, and blending is smoothly assembling an ordered phoneme sequence into an approximation of the spoken word. These complementary tasks demonstrate for children that a spoken word is composed of recognizable elements that can be manipulated. Children who can perform these tasks no doubt have more than enough phoneme awareness to learn to decode.

However, training in segmentation and blending does not always lead children to master phoneme awareness (e.g., Smith, Christensen, Goodale, Ingebrand, & Steel, 1993; Torneus, 1984). Byrne and Fielding-Barnsley (1990) present evidence that segmentation and blending may themselves be difficult tasks when children lack sufficient familiarity with the identities of the particular phonemes from which the stimulus words are constructed. They suggest that phoneme awareness be taught through instruction in particular phoneme identities.

The problem. Do children better learn about the phonemic structure of words through instruction in generalized segmentation skill or in particular phoneme identities? The question is important because skill training should be accomplished efficiently. Rapid acquisition of the mechanics of deciphering can permit early independence in reading. Some programs very costly in terms of time on task (e.g., Lundberg, Frost, & Petersen, 1988) have produced fairly small differences in later reading achievement. An important task in current phoneme awareness research is to specify the methods that are most effective in helping children learn to recognize and manipulate the phonemes in spoken words.

The question is also important because it can inform us about theoretical issues in reading acquisition. Is the key phoneme awareness ability that prepares children for alphabetic reading segmentation skill or knowledge of phoneme identities? How are blending and segmentation abilities related to reading acquisition? What part does phoneme awareness play in learning to read? Learning whether phoneme awareness is better acquired through instruction in generalized segmentation skill or in particular phoneme identities is important for constructing a model of reading acquisition.

Comparing Segmentation and Identity

Segmentation. The discussion of phoneme awareness has historically been framed as questions about segmentation and blending, with primary emphasis on segmentation (Elkonin, 1973; Lewkowicz, 1980; Liberman, 1973). Segmentation seems in theory to lie at the heart of the problem of gaining the alphabetic insight that a word's spelling maps the phonemic sequence of its pronunciation. Recognizing a phonemic sequence might be hypothesized to lie at the conclusion of a process of making increasing fine-grained divisions of the phonological parts of spoken discourse, from utterance to word, from word to syllable, from syllable to onset and rime, from onset or rime to phoneme.

However, the term segmentation, with its implication of cutting or setting boundaries, may be a misleading designation. Viewing segmentation as a progressive search for the distinct sound qualities in spoken language leads to both theoretical and practical problems. In speech, phonemes are not acoustically discrete, but are thoroughly interconnected in their encoding (Liberman, Cooper, Shankweiler, & Studdert-Kennedy, 1967). In the context of a spoken word, a phoneme may be changed by the production of nearby phonemes. For example, the /t/ at the beginning of train closely resembles the phoneme /ch/. Segmentation, then, requires more than a mechanical division of the acoustic signal.

Operationalizing segmentation. Segmentation also presents perplexing practical problems. Segmentation tasks (Stahl & Murray, 1994; Yopp, 1988) usually require the subject to articulate all the phonemes of a word in sequence, e.g., "What are the three sounds in soup?" As a practical matter, pronouncing all the phonemes of a word in sequence is among the most difficult of phoneme awareness tasks (Helfgott, 1976; Yopp, 1988). Young children trying to segment a word into phonemes may articulate words into parts larger than a phoneme, e.g., cluster onsets (Treiman, 1985) or consonant-vowel segments (Skjelfjord, 1987). Segmentation tasks often stymie children otherwise well along into reading (Stahl & Murray, 1994). If children can read with some fluency but cannot accurately and fully segment words into phonemes, it is difficult to argue that segmentation is a reading prerequisite.

Phoneme identification. Lewkowicz (1980) describes segmentation as a process of searching for familiar elements in a spoken word. This plausible account suggests a process quite different from a division of a spoken word into subsyllabic parts. It suggests the central task in segmentation is identifying the phonemes in a syllable.

Identity and identify are derived from the Latin word idem, meaning same; to identify a phoneme is to perceive it as the same sound repeated across different words. Segmenting and identifying represent divergent descriptions of how children gain a working knowledge of phonemes in coming to understand and use the alphabetic principle in early reading and spelling.

Identifying phonemes seems to be implied in the exemplary segmentation teaching procedures described by Lewkowicz (1980). The identity of a phoneme might be learned by stretching or iterating sounds in a syllable and attending to both the sound and the gestures involved in producing the sound. For example, learning the identity of /m/ probably involves hearing its characteristic humming sound and examining the gesture of closing the lips and vibrating the vocal cords while expelling air through the nose. What is crucial is that this vocal gesture, with its accompanying sound, becomes a familiar entity that can be recognized as common to large numbers of spoken words.

Operationalizing phoneme identification. The question of which task best operationalizes the concept of phoneme identification is unsettled. Such a task would have to reveal if, for the child, phonemes are stable and familiar entities that

can be perceived across different words. Byrne and Fielding-Barnsley (1990, 1991) and Stanovich, Cunningham, and Cramer (1984) rely on word-to-word matching. In word-to-word matching, the subject compares two or more spoken words for a common phoneme identified only by location, e.g., "Does soup start like sand?" Illustrations may be used to ease the burden on working memory occasioned by the multiple comparisons. Bradley and Bryant (1978, 1983, 1985a, 1985b) use a phonological oddity task, essentially a negative version of word-to-word matching, in which the subject is to find a word that is phonologically dissimilar at a given position.

In sound-to-word matching, the comparison is simplified by isolating the target phoneme for the subject. For example, Wallach and Wallach (1979) told participants, "Some words start with the sound /m/, like Ma or mud or me," and asked them to decide which illustrated word matched the isolated sound ("Does man or house start with /m/?"). Despite the apparent ease of this task, it effectively discriminated children who were better prepared for literacy instruction from others who were less prepared.

A further possible operationalization of phoneme identity is phoneme isolation, e.g., "Tell me the sound you hear at the beginning of each word I say. For example, if I say fix, you say /f/" (Stahl & Murray, 1994; Yopp, 1988). It is possible that phoneme isolation tasks call upon phoneme identity knowledge by requiring subjects to analyze a given location in words for stable, phoneme-sized units, although such tasks do not require a demonstration of identity across example words. Whatever their prerequisites, these tasks measure a level of phoneme awareness that appears to be necessary for reading acquisition (Stahl & Murray, 1994).

Research by Byrne and Fielding-Barnsley. Byrne and Fielding-Barnsley (1989, 1990) attempted to empirically distinguish identity knowledge from segmentation skill as part of a line of research in which they sought to specify what preliterate children need to know to accomplish the most rudimentary form of phonological recoding. Ehri (1991) terms this simple recoding phonetic cue reading, translating initial or boundary letters into phonemes in order to access partially activated words. To operationalize this ability, Byrne and Fielding-Barnsley developed a forced-choice transfer paradigm. After learning to recognize, for example, fat and bat, and given printed pairs of words differing only in the initial consonants f and b, children were said to have acquired rudimentary recoding skill if they could subsequently point out, e.g., whether fun is read "fun" or "bun," and whether fell is read "bell" or "fell," with above-chance consistency. Note that phonetic cue reading is adequate for this task, since accurate recoding of the initial consonant sound is sufficient to distinguish the two words.

In the first series of experiments, Byrne (1992) established that preliterate children who learn to recognize words, whether in alphabetic English or in a novel orthography, rarely if ever induce the spelling-to-sound correspondences needed for success on the forced-choice transfer task. Children did, however,

succeed on a transfer task in which the symbols had semantic values; for instance, when they learned the symbols for "little boy" and "big boy," they were able to transfer this knowledge to distinguish "little fish" from "big fish." Thus, dealing with abstract symbols was not the problem; their failure to induce the alphabetic principle owed to their difficulties in identifying phoneme-sized units in spoken words. Without explicit help, preliterate children are generally unable to tie regularities in the phonemic construction of spoken words to regularities in spellings.

Byrne and Fielding-Barnsley (1989) proceeded to test a model involving explicit correspondence instruction and two phonemic awareness abilities, segmentation and identity. They trained preschoolers to segment words into onset (here always the phonemes /m/ or /s/) and rime (the vowel and any final consonants) by demonstrating segmentation with a puppet and then encouraging participants to work the puppet and segment the words. They further trained the children to identify phonemes by pronouncing the phonemes /m/ and /s/ in isolation, stretching the sounds in example words, and then guiding practice in word-to-word matching (e.g., "Which word starts with the same sound as mat: Is it mum or sum?"). Finally, they taught the children to associate the symbols with their sound values by paired associate methods. These experiments showed that together segmentation, identity, and knowledge of correspondences are sufficient in most cases for children to demonstrate the simple phonetic cue reading required by the forced-choice transfer paradigm.

The yet unresolved question of the relative efficacy of identity knowledge and segmentation ability was addressed in Byrne and Fielding-Barnsley (1990), which examined whether phoneme awareness is taught more efficiently by instruction in phoneme identities or in segmentation. In the first experiment, 16 children were individually taught to identify four phonemes, /s/, /m/, /t/, and /sh/. The experimenter displayed illustrations of words that began with each target phoneme (e.g., /s/), named the items, and told the child that "they all start with /s/." Children learned the names by repeating them three times, and also examined words ending with the target sound. The instructional demonstration was followed with practice in selecting from among foils spoken words that started with or ended with the target phoneme. Later each child was taught the sounds corresponding to the letters s and m. Children were tested using sound-to-word matching tasks and with the forced-choice phonetic cue reading task described previously (e.g., "Is this mow or sow?). After additional correspondence training, children were asked to distinguish words beginning with f and b, which represented phonemes whose identities had not been taught.

The effectiveness of identity training did not seem to depend on whether the phoneme was found at the beginning or the end of the word. On the phonetic cue reading task, the 9 who reached a criterion of 7 out of 8 correct were the 9 children with the highest identity scores. Remarkably, five of these children also reached criterion on phonetic cue reading with untrained phonemes, the first instance in the research program

where children successfully used correspondence information for untrained phonemes on the phonetic cue reading task. Success on this transfer task suggests that children who learn to identify some phonemes can adapt their learning to other phonemes, and thus do not require training on all the phonemes in the language. They are, as it were, ready for phonics instruction.

In a parallel segmentation-training experiment, 16 children imitated a puppet model to learn to segment initial and final consonants. The same illustrated words, composed of the limited set of phonemes, served as stimuli. On the phonetic cue reading task, only 5 children reached criterion, and these were not all among the best segmenters. Again, however, 5 children reached criterion on phonetic cue reading with untrained phonemes, suggesting that these children had achieved insight into the alphabetic principle. It is possible that these children had learned about the identity of phonemes because segmentation practice was restricted to the limited phoneme set. In support of this view, their scores in phoneme identity averaged nearly as high as those of children trained in identity, and the test used to measure identity was the more difficult sound-to-word matching with three foils instead of two.

In general, phoneme segmentation showed a weaker relationship to phonetic cue reading as seen on the reading analog task. Identity scores (r = .49) were better predictors of performance in phonetic cue reading than segmentation scores (r = .20). Byrne and Fielding-Barnsley (1990) conclude that phoneme identity training is more successful than segmentation training in leading children toward the alphabetic insight because identity is easier to teach and leads to a more stable alphabetic insight. They also informally observed that children were more comfortable with identity training, which did not require corrective feedback and seemed to engender less frustration.

Limitations of Byrne and Fielding-Barnsley's research. Though tantalizing, Byrne and Fielding-Barnsley's research does not conclusively establish whether segmentation and identity training differ in their effectiveness. The segmentation and identity groups were not directly compared on their reading analog performances, and there is no strong indication that such a comparison would favor the identity group. The frustration associated with segmentation training was observed informally but not measured. Moreover, segmentation training seemed to lead to roughly equivalent levels of identity knowledge and to alphabetic insight.

The likely reason for the unexpected success of the segmentation participants is that by restricting examples to a limited phoneme set, the experimenters repeatedly called attention to the identities of these phonemes and provided extended opportunities to examine their articulation and to locate them in word contexts. In other words, identity and segmentation treatments were confounded. A clearer test of the relative effectiveness of segmentation and identification training would require eliminating instruction in identity from the segmentation training.

Developing Phoneme Identification Skill

But what sort of instruction teaches phoneme identity? In two recent training studies (Torgesen, Morgan, & Davis, 1992; Torgesen, Davis, & Wagner, 1993, cited in Torgesen, Wagner, & Rashotte, 1994), nearly a third of the participants showed no measurable growth in phonological awareness, notwithstanding the general effectiveness of the programs in which they participated. These children may require more explicit, focused, and systematic instruction to learn to identify phonemes and to succeed in literacy instruction (Blachman, 1994; Torgesen et al., 1994).

Effective phoneme awareness instruction seems to be distinguished by a focus on phonemes, including examination of the articulatory boundaries of phonemes; measures to make phonemes memorable; and practice in locating phonemes in the context of spoken words.

A Focus on Phonemes

Effective phoneme awareness training tends to focus children's attention on particular phonemes (rather than on larger subsyllabic parts, or on some generalized segmentation skill) and takes advantage of differences in the salience of particular phonemes for particular tasks. Many studies ease the task of phoneme analysis by beginning with 2-phoneme words (VCs and CVs) and progressing to 3-phoneme words (CVCs) (Ball & Blachman, 1991; Davidson & Jenkins, 1994; Haddock, 1976; Lie, 1991; Lundberg et al., 1988). Words of two or more syllables or with consonant clusters are probably too difficult for phoneme identity instruction (Lie, 1991; Stahl & Murray, 1994).

Phoneme types and positions. Researchers teaching phoneme awareness often introduce continuant consonants (consonants whose sounds can be stretched in isolation) and vowel sounds before stops (Ball & Blachman, 1991; Lie, 1991; Lundberg et al., 1988). Researchers generally agree that the beginning of a syllable is ordinarily the most salient position for identifying phonemes (Content, Kolinsky, Morais, & Bertelson, 1986; Lie, 1991; Lundberg et al., 1988), and that phonemes in the medial position are consistently the hardest to recognize (Skjelfjord, 1976).

Stretching phonemes. Stretching or elongating a phoneme apparently allows the child time to examine its production, i.e., what the voice, tongue, and lips are doing as the sound is formed (Skjelfjord, 1976). Researchers who train segmentation often model the stretched phoneme for children and ask children to imitate their model (Lewkowicz & Low, 1979; Lie, 1991; Lundberg et al., 1988; O'Connor, Jenkins, & Slocum, 1994; Skjelfjord, 1976), thereby likely adding an aspect of identity instruction.

Isolating phonemes. Stretching phonemes in words is often a step toward isolating those phonemes in segmentation (e.g., O'Connor et al., 1994). Others demonstrate phoneme isolation directly (McNeil & Stone, 1965). Although pronouncing phonemes in isolation has frequently been criticized from a linguistic point of view (e.g., Tunmer & Rohl, 1991), informal observations suggest that children experience little difficulty in abstracting phonemes from such approximations, provided that any additional voicing is a brief schwa common to all voiced consonants (Wallach & Wallach, 1979).

Locating articulatory boundaries. Isolating and stretching the vocal gestures used in pronouncing phonemes offer means of discriminating the articulatory boundaries of phonemes. Although some researchers find it advisable to provide direct instruction in how sounds are produced (Calfee, Lindamood, & Lindamood, 1973; Wise & Olson, 1994), others view articulation as a matter more appropriately studied via discovery learning (Lie, 1991; Skjelfjord, 1976). Rather than explaining to children how sounds are made, these researchers ask children to examine the position of the tongue and lips and to note whether sound is made in the voice box.

Making Phonemes Memorable

If the task of phoneme awareness education is to help children become familiar with phonemes, then teaching methods should aim at making phonemes memorable. If we assume that the phoneme, once initially identified, is represented by some node in long-term storage, that representation is memorable to the degree that it can be readily activated through multiple, well-traveled access routes. Restricting the initial set of phonemes to be identified is one way to aid memory for phoneme identity. Visual symbolization through semantic illustrations (Venezky & Chapman, 1970) or with letters (Ball & Blachman, 1991) can also help children remember phonemes.

Limited phoneme sets. Using a limited phoneme set for initial phoneme awareness instruction helps the beginner develop a few retrieval routes more completely until he or she gains a more generalized insight into the phonemic composition of spoken words. This limited set may be composed of fewer than 10 phonemes (Ball & Blachman, 1991; Byrne & Fielding-Barnsley, 1991; Content, Morais, Alegria, & Bertelson, 1982; Haddock, 1976; Hohn & Ehri, 1983; McNeil & Coleman, 1967). As elements of this limited phoneme set, many researchers select long vowels (Davidson & Jenkins, 1994; Hohn & Ehri, 1983), which seem to be inherently more salient (Coleman, 1970), probably because their phonological values are the same as their letter names. In contrast, short vowel sounds are among the most difficult phonemes to distinguish in word contexts (Coleman, 1970).

The selection of phonemes may also be guided by plans for reading analog tasks (O'Connor, Jenkins, Leicester, & Slocum, 1993). For example, McNeil and Coleman (1967) selected seven phonemes to train (/I/, /E/, /i/, /p/, /d/, /n/, and /k/), which later appeared in 15 words for the children to decode. Teaching identities for the specific group of phonemes that appears in words to be read during posttesting provides a strong test of the claim that learning to identify phonemes facilitates learning to recognize words.

Linking phonemes to letter names. The oldest means of making phonemes memorable is by symbolizing them with the letters of the alphabet. According to Hohn and Ehri (1983), "Letters in spellings provide discrete, lasting symbols for sounds that are short-lived and that have no boundaries but, rather, overlap with other sounds in spoken words." Learning letters as visual symbols for the elusive and ephemeral vocal elements in spoken words seems to be an effective means of making phonemes

memorable, and perhaps the typical way children learn phoneme identities.

Children taught to symbolize phonemes with letters find those phonemes easier to retrieve than other phonemes (Bradley & Bryant, 1983; Hohn & Ehri, 1983; Marsh & Mineo, 1977). Hohn and Ehri (1983), after finding the letter-trained kindergartners superior in segmentation ability to children who represented phonemes with plain counters, suggest that the letters form an additional link to memory for phonemes children learn to identify.

Providing semantic referents. One other possibility for making phonemes memorable is to represent them with meaningful images that call a similar sound to mind (e.g., Lebo, Hughes, & Thomas, 1975; Venezky & Chapman, 1970). For instance, the phoneme /h/ might be represented by a drawing of a man blowing warm breath onto a pair of glasses as he prepares to clean them. Because semantic representations offer explicit links with phonemes, they may, like letters, serve as effective retrieval cues for phonemes under study.

Identifying Phonemes in the Context of Spoken Words

While attending to phonemes, recognizing their articulatory boundaries, and building retrieval routes to representations of phonemes are important steps to phoneme awareness, knowledge of phoneme identities is not complete until it is applied in the context of spoken words. Even in the days when researchers routinely conflated auditory discrimination and phoneme awareness, it was recognized that a central problem in reading acquisition was "to identify sounds in spoken words" (Durrell & Murphy, 1953).

Sound-to-word matching. Probably the simplest means of drawing an explicit link between phonemes and spoken-word contexts is sound-to-word matching, which entails asking children to find an explicitly pronounced phoneme in spoken words. A simple initial task is to probe recognition, e.g., "Does the word mat begin with an /m/ sound?" (Rosner, 1971). A slightly more advanced task is responding to forced choices with only two alternatives, e.g., Which word begins with /m/, gnat or mat? (Byrne & Fielding-Barnsley, 1990; Marsh & Mineo, 1977). Both of these formats have been successfully employed with low-readiness beginners in the Wallach and Wallach (1976, 1979) program, leading to gains in phoneme awareness, word recognition, and reading comprehension.

Word-to-word matching. A common feature of many readiness programs is word-to-word matching, a relatively difficult activity in which children are typically asked both to name pictures and to analyze their names for common sounds (e.g., Modern Curriculum Press, 1991). Besides the ambiguity of the picture names, word-to-word matching presumes a high degree of familiarity with phonemes for identification to take place rapidly and with little drain on the attentional resources needed to make comparisons with other words.

However, once children are well grounded in phoneme identities, word-to-word matching activities seem to provide appropriate practice in locating phonemes in word contexts, and

researchers have frequently included such activities in their training programs with positive results (Ball & Blachman, 1991; Bradley & Bryant, 1985; Content et al., 1982; Olofsson & Lundberg, 1983). These programs first familiarize children with phonemes by other means, such as isolating phonemes (McNeil & Coleman, 1967).

Tongue twisters and alphabet books. Tongue twisters and alphabet books exercise knowledge of phoneme identities in word contexts by providing numerous examples of words with common initial phonemes. Alliterative tongue twisters (e.g., "John got juice and jelly on his jacket when Judy jumped on him," Wallach & Wallach, 1976) are commonly used to intrcduce phoneme awareness instruction (Content, Morais, Alegria, & Bertelson, 1982; Lie, 1991; Skjelfjord, 1976; Wallach & Wallach, 1979), perhaps because they set up a problem for children to solve through insight into phonemic composition. Wallach and Wallach (1979) simply asked children to pronounce words with a pause after the initial phoneme (e.g., r-ake; p-ot) and found this technique to be their most effective means of teaching phoneme identities.

Similarly, alphabet books usually provide several examples of words with common initial sounds, and in addition, symbolize that sound with a letter. Recent evidence suggests that children's attempts to discover a common sound among the examples provides useful data in learning about phoneme identity (Murray, Stahl, & Ivey, 1993).

Advanced phoneme awareness tasks. In general, work in segmenting and blending seems to develop phoneme awareness at the level of integrating understanding of phoneme identity into the contexts of spoken words. Like word-to-word matching, segmentation and blending tasks demand a relatively advanced level of phoneme awareness, but they also exercise phonological capabilities closely related to reading (Lewkowicz, 1980).

Blending, also called synthesis, is ordinarily assessed by pronouncing all the phonemes of a word or pseudoword in sequence and asking a child to report the word. Commonly, blending is taught just as it is assessed, with the provision of feedback about the success of children's efforts (Fox & Routh, 1976, 1984).

Researchers who have attempted to break down a skill sequence for the development of blending have proceeded in several ways. Torgesen et al. (1992) initially gave children in a segmentation-blending group practice in identifying initial, medial, or final sounds in 2- or 3-phoneme words and pseudowords. When children became adept at isolating sounds at each position, they learned to segment words fully, and then to blend. Content et al. (1982) asked children to blend a phoneme practiced in tongue twisters, isolation, and classification exercises to the beginning or ending of words to create nonsense words (e.g., /b/ added to igloo to form bigloo). More research is necessary to analyze the skill of blending into easily learned increments.

Summary

Children with adequate phoneme awareness, whether gained through a literacy-rich environment with ample word play (Maclean, Bryant, & Bradley, 1987), through inherited

sensitivities (Olson, Wise, Conners, Rack, & Fulker, 1989), or by other means, will learn to read without extensive training in phonological awareness. Other children require some degree of explicit help in recognizing phonemes in spoken-word contexts.

My survey of the training literature on phoneme awareness suggests that such help begins with a focus on phonemes through stretched sounding and phoneme isolation in a careful progression that considers the number and choice of phonemes and position in syllables. Stretching and isolating phonemes allows beginners to explore their articulatory boundaries and begin to create a representation in memory. After their initial introduction, phonemes can be made familiar and memorable through use of a limited phoneme set and by teaching letter names, semantic referents, or both.

The crucial step in gaining a working phoneme awareness is learning to identify phonemes in the context of spoken words. Through experiences with tongue twisters and alphabet books, sound-to-word matching, and word-to-word matching, through segmentation and blending practice, and through spelling-to-sound instruction, beginners learn to perceive the phonemic composition of words and link phonemic manipulations with the subroutines of reading and spelling.

Redefining Phoneme Awareness

The research literature on phoneme awareness has largely assumed that the essential phoneme awareness task is segmentation. Considering the task of discovering the mapping between word spellings and pronunciations, segmentation ability seems credible as a mediator in decoding, and some experimental results (e.g., Ball & Blachman, 1991; Cunningham, 1990; Torgesen et al., 1992) support its facilitative effect on decoding. However, other experimental results suggest that not all phoneme awareness training "takes" (e.g., Davidson & Jenkins, 1994; Olofsson & Lundberg, 1983, 1985; Smith et al., 1993). Beyond the uneven experimental results, there is conceptual confusion associated with the segmentation view of phoneme awareness. The idea of a mechanical separation of phonemes does not carry with it a plausible means of dividing the spoken word.

The solution to these empirical and theoretical difficulties is a new conceptualization of phoneme awareness as, at root, a matter of recognizing phoneme identities rather than segmenting words into component phonemes. The evidence presented by Byrne and Fielding-Barnsley (1989, 1990, 1991; Byrne, 1992) suggests that phoneme identity knowledge is more closely related to reading acquisition than is segmentation. Moreover, successful attempts to train segmentation often seem heavily weighted with activities likely to teach phoneme identities (e.g., Ball & Blachman, 1991; Bradley & Bryant, 1983; Lie, 1991; Torgesen et al., 1992; Williams, 1980).

Phoneme identity theory resolves the blending versus segmentation argument by viewing each of these tasks as more advanced applications of a single primary skill in identifying phonemes. Successful blending depends on familiarity with the phonemes to be blended both in isolation and as components of words. Accordingly, blending seems more appropriate as a second-

stage phoneme awareness ability, an advanced skill built on a foundation of knowledge of phoneme identities.

Segmentation, too, usually depends on knowledge of phoneme identities. Reporting the entire sequence of phonemes in a syllable demands knowledge of the identities of each phoneme to be reported. Because multiple representations must be activated, segmentation takes a heavy toll on working memory. Memory demands are typically eased through the mediation of letters or simple spellings to visually represent phonemes (Ehri, 1984).

Phoneme awareness and beginning reading. How does phoneme awareness play out in learning to read? Learning to read well seems to depend on attaining independence and fluency in decoding (Adams, 1990). Decoding is generally learned in two phases (Ehri, 1994): phonetic cue reading and phonological recoding.

Phonetic cue reading appears to be built on knowledge of phoneme identities. In phonetic cue reading, a letter or simple spelling, as a visual symbol for a phoneme known to be a common element of spoken words, activates that phoneme sufficiently for lexical access with memorized texts, forced-choice tasks, or a constraining semantic context. For instance, "three blind m---" is sufficient information to activate mice. Knowledge of phoneme identities, but not segmentation skill, seems to be implicated in phonetic cue reading. Gaining access to a primed lexical entry via a phonetic cue does not seem to require a full understanding of the segmental structure of a spoken word, but only a working knowledge of the familiar vocal element cued by the initial or boundary letter. The same word mice, unprimed and seen in isolation, is likely to be inaccessible to phonetic cue readers.

Context-free phonological recoding, a powerful and reliable means of recognizing and remembering words, requires more highly developed phonemic and orthographic knowledge to rapidly activate the sequence of phonemes cued by the letters in a spelling. Blending is implicated in recoding. To recode, the reader must hold the phoneme sequence in working memory and unite the separate gestures into an approximate pronunciation leading to lexical access. Segmentation may also be useful in cross-checking the proposed solution to a blending problem to see whether its phonemes correspond to the spelling.

Segmentation is implicated in skilled word recognition and in spelling ability. To recognize a word at sight requires a well-developed word representation in the lexicon, an amalgamation of the phoneme sequence and the spelling (Ehri, 1992; Perfetti, 1992). To become skilled in word recognition probably requires some segmentation ability to forge multiple linkages between phonemes in the pronunciation and grapheme units in the spelling, so that the written word comes to serve as a visual symbol for the spoken word.

Knowledge of phoneme identities seems to play a role in both blending and segmentation. Segmentation and blending are typically mediated by knowledge of grapheme-phoneme correspondences. The use of printed letters to represent phonemes disencumbers working memory to permit these complex phonological manipulations during recoding and in acquiring amalgamated representations for sight word recognition. This has

an important instructional implication: If the complex phoneme awareness abilities of blending and segmentation are ordinarily mediated by knowledge of spelling-to-sound correspondences, they are more efficiently learned after correspondences have been learned. The use of letters as stable representations for ephemeral phonemes enables these useful but intricate manipulations.

To summarize the proposed model of reading acquisition, knowledge of phoneme identities and letter identities are necessary for learning grapheme-phoneme correspondences. Knowledge of correspondences then enables the use of letters as visual symbols of phonemes, making it possible for letters to become mediators in working memory. The ability to recognize letters as symbols for phonemes enables the initial decoding breakthrough of phonetic cue reading and facilitates the more advanced phonemic manipulations of blending and segmentation during phonological recoding. In general, attaining sufficient familiarity with phoneme identities to recognize them in the context of spoken words seems to be the initial hurdle in learning to read.

The ability to read the thousands of words in one's listening vocabulary rapidly and automatically in comprehending the ideas of a text is a remarkable achievement that has been likened to the ability of a chess master to rapidly assess game positions, or of a concert pianist in performing a complex musical score (Just & Carpenter, 1987). Mastery of reading, chess, or piano appears deceptively effortless; each depends on the orchestration of many skills, learned through years of practice. In reading, the skills on which all others depend are the identification of phonemes and the recognition of letters. By using well-tested strategies for teaching children phoneme identities, we can strengthen the foundation of reading mastery.

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